

Midwest ISO Daily Operations and Wind Energy



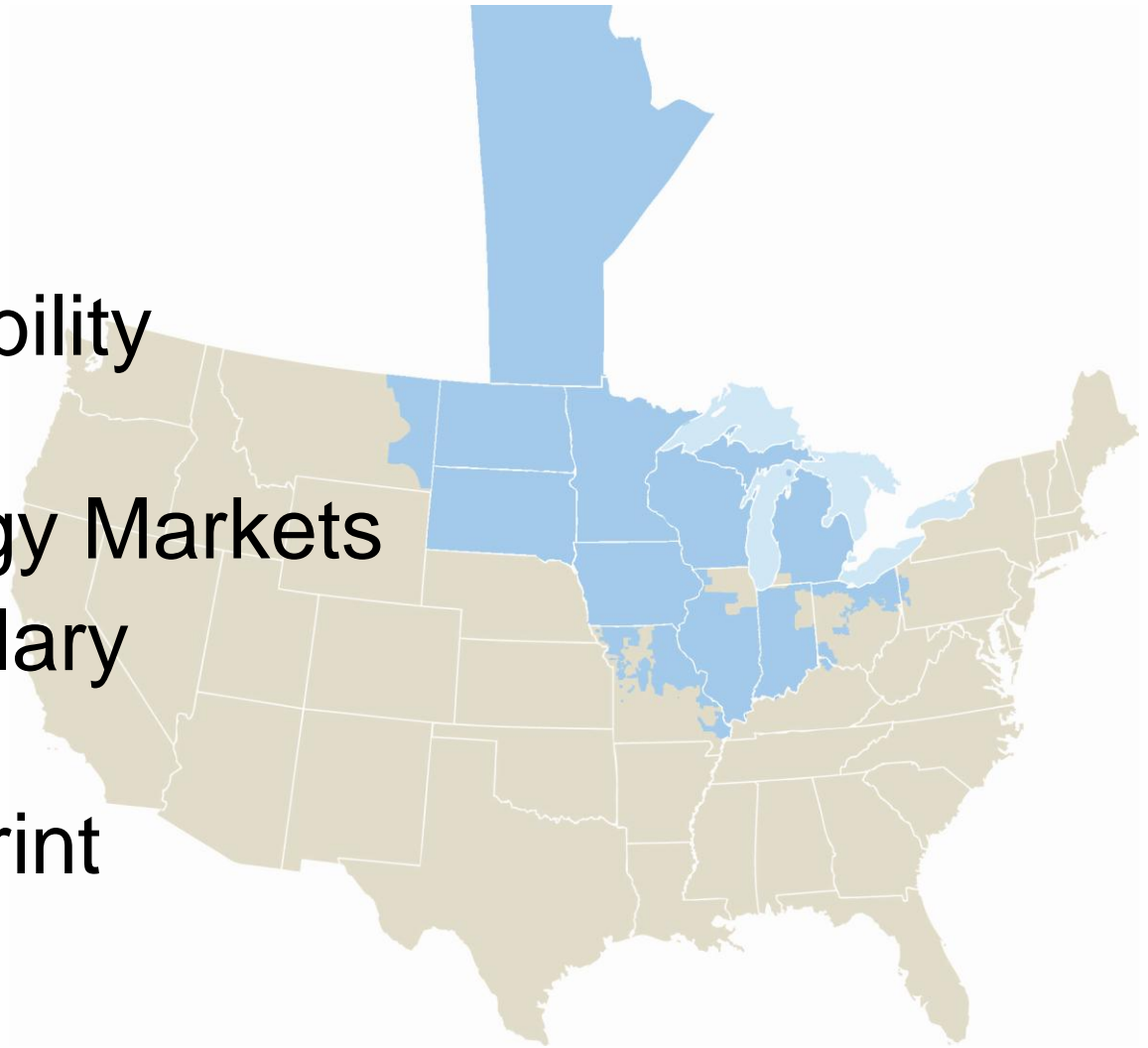
Kris Ruud
WIndiana,
July 21, 2010

Summary

- Midwest ISO Overview
- Wind Penetration in the Midwest ISO
- Wind Benefits in the Midwest ISO
- Challenges of wind in Midwest ISO
- Ongoing Wind Integration Efforts

Midwest ISO Overview

- Independent
- Non-profit
- 2001 - Reliability Coordinator
- 2005 - Energy Markets
- 2009 – Ancillary Services
- Large Footprint



Scope of Operations

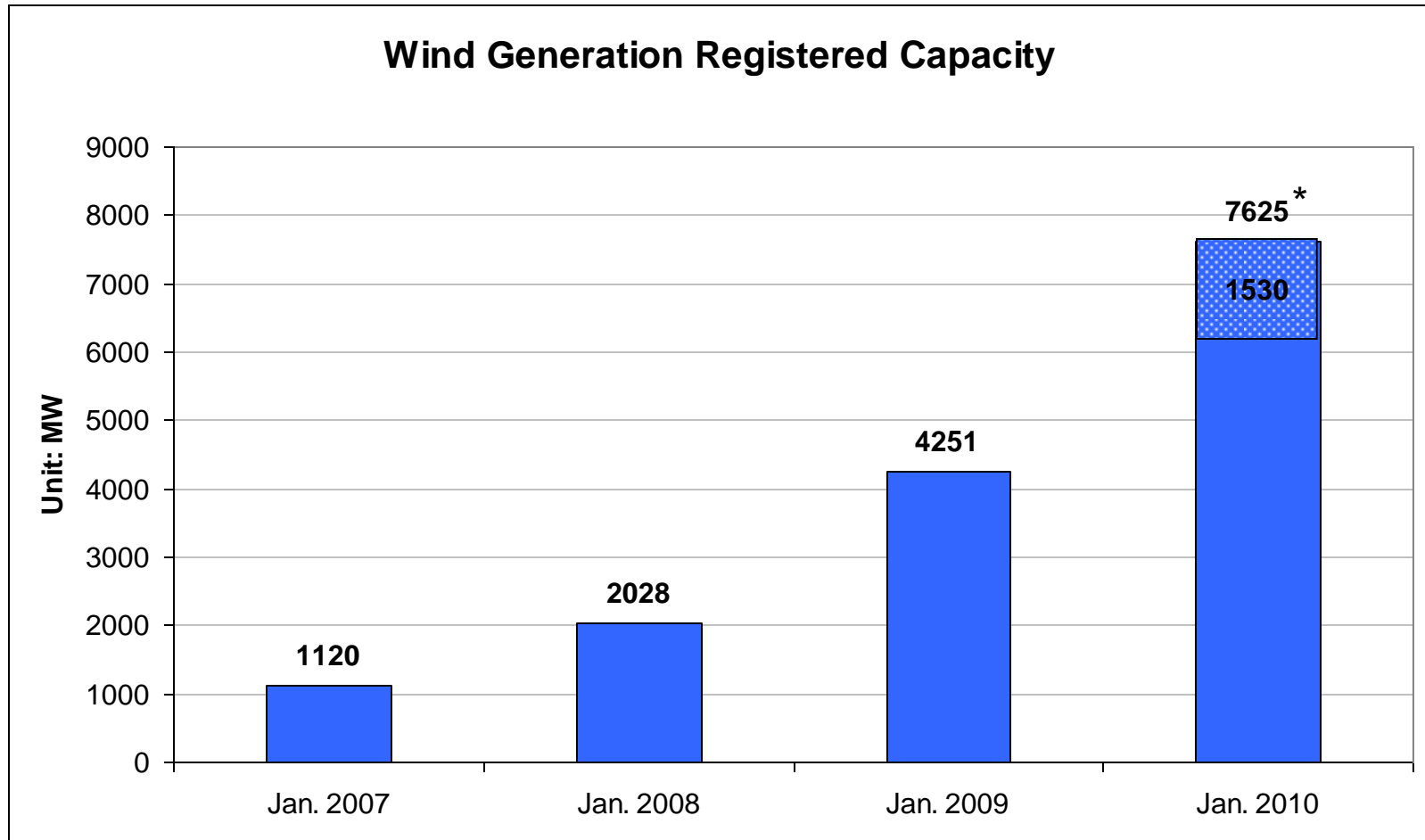
- Generation Capacity
 - 144,132 MW (market)
 - 159,000 MW (reliability)
- Historic Peak Load
(set July 31, 2006)
 - 116,030 MW (market)
 - 136,520 MW (reliability)
- 56,300 miles of transmission
- 13 states, 1 Canadian province
- 5-minute dispatch
- 2,107 pricing nodes
- 5,644 generating units in the network model
- ~ \$23 billion per year settled in energy markets (09)
- 347 market participants serving 40+ million people

Midwest ISO Market Footprint



Wind Penetration in the Midwest ISO

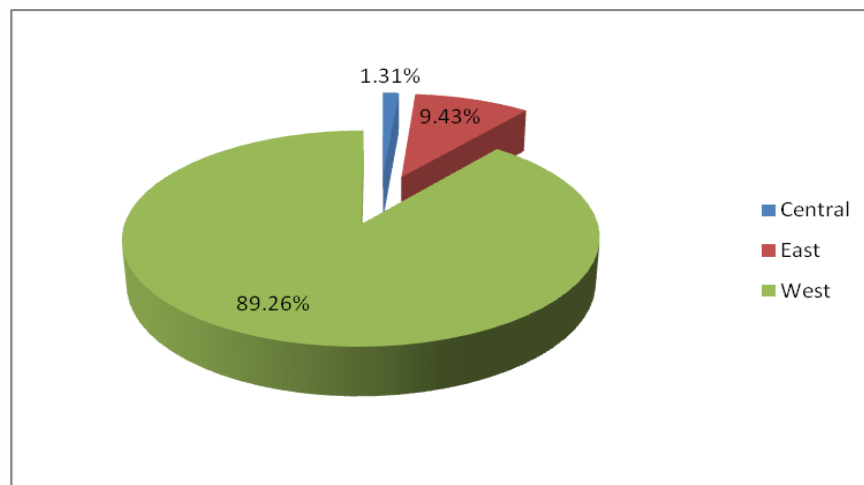
Wind Generation Growth in the Midwest ISO Market



Wind Generation within Midwest ISO

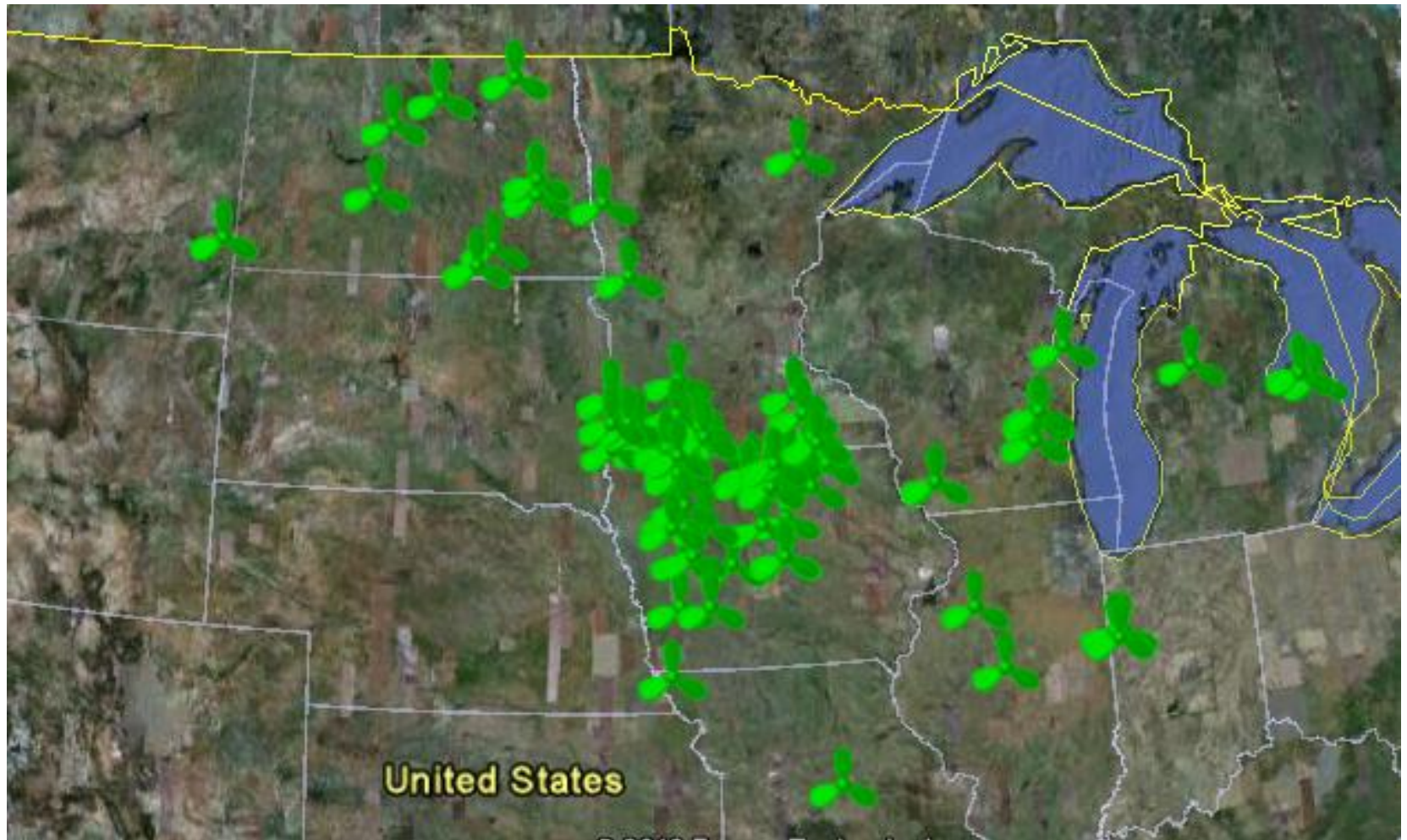
- Wind Generation Registered Capacity as of July 1, 2010
 - Total registered wind generation capacity: 8168.65 MW
 - Wind resource represents 5.6% of the total registered capacity

- Wind Generation Distribution



- Wind Output Statistics
 - On average, wind resources generate at 30% of its total capacity
 - Historically wind generation output ranges from 1% to 72% of its total capacity

Wind in the Midwest ISO

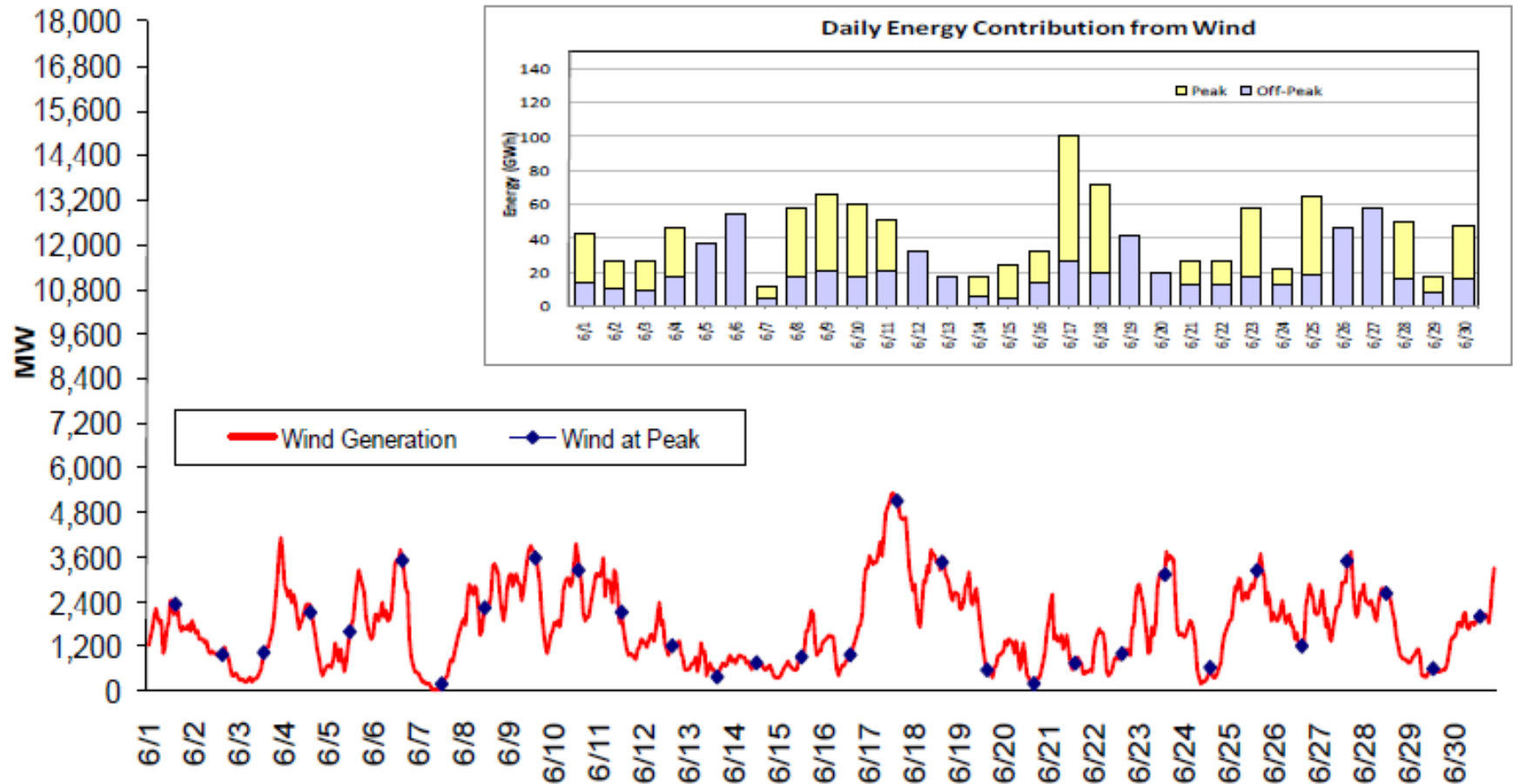


Wind Benefits in the Midwest ISO

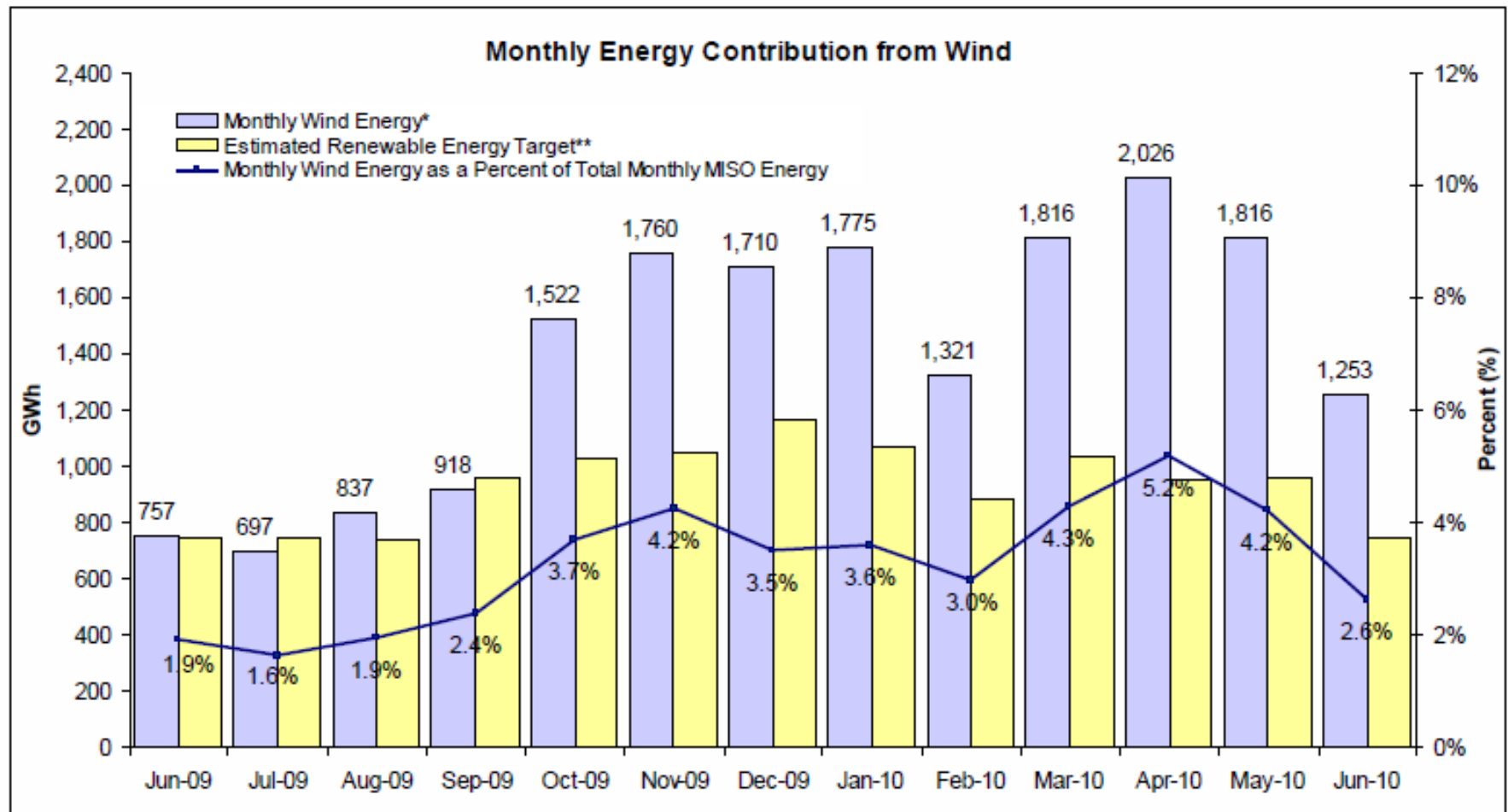
Wind Utilization

Registered Capacity = 8,169 MW

Hourly Energy Contribution from Wind June 2010



Wind Utilization



**Monthly wind energy generated (light blue) compared to monthly renewable energy target (yellow bar) to satisfy aggregate State RPS mandates within Midwest ISO's market footprint. Additional information can be found at www.midwestiso.org under the [Documents, Committee Meetings and Presentations, Wind Integration, Estimated Wind Contribution to State RPS Background Information](#) directories.

*Hourly ICCP data

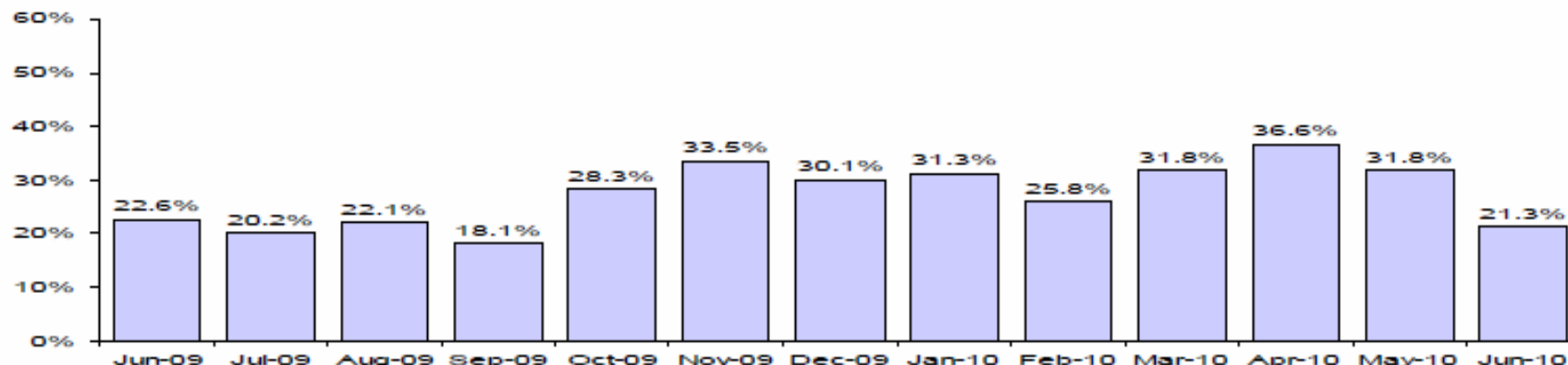


** Yellow bar represents the annual renewable energy target distributed by month based on monthly capacity factor expectations of the Midwest ISO system.

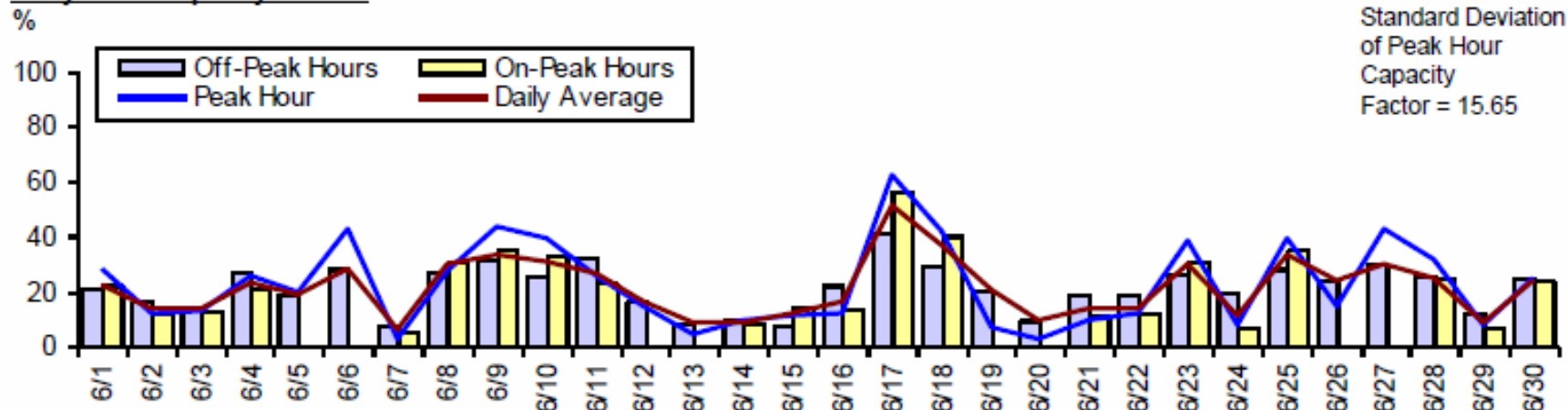
Source: Midwest ISO Real-Time Operations and Transmission Asset Management Departments

Wind Utilization

Monthly Wind Capacity Factor*



Daily Wind Capacity Factor*



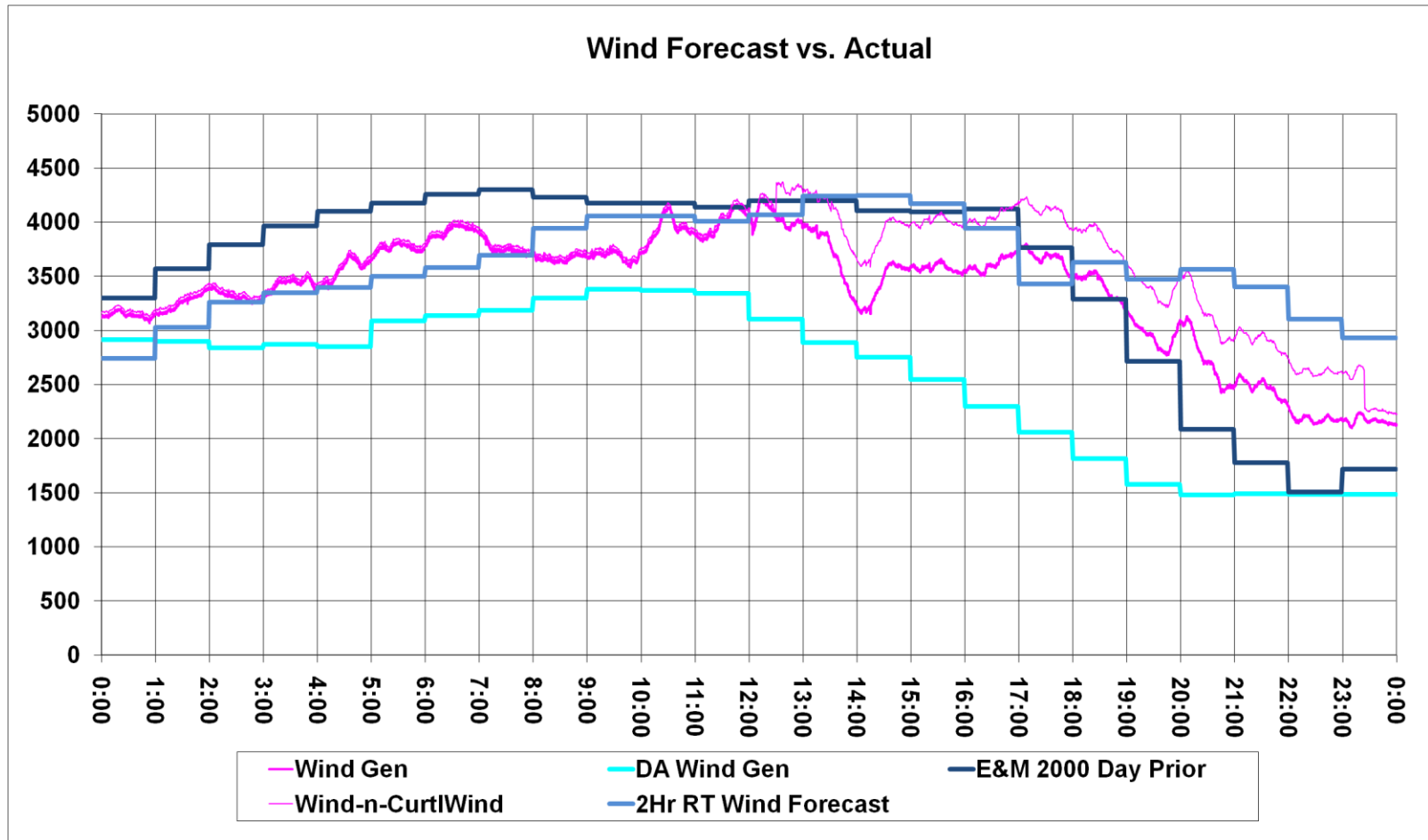
* Wind Capacity factor is calculated by dividing actual generation by the registered capacity.

Wind Challenges in the Midwest ISO

Three Primary Types of Challenges

- Capacity/Ramp Uncertainty
- Operations Planning
- Transmission Congestion

Capacity and Ramp Uncertainty



Operations Planning Challenges

What do we assume for a wind output when doing:

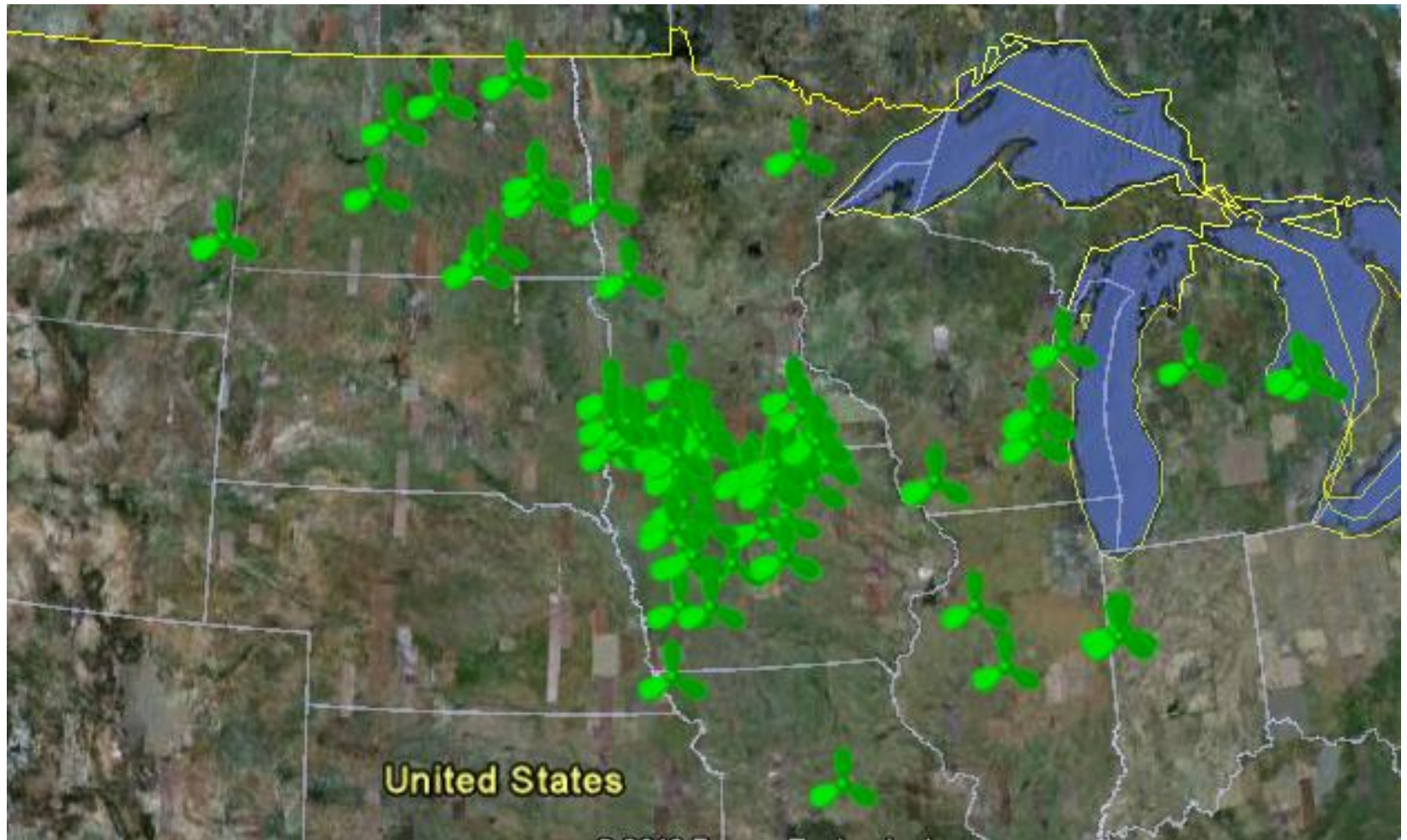
- Outage coordination
- AFC coordination

In addition to overall wind output, the distribution pattern can have an impact on constraints

Transmission Congestion

- High penetration of wind generation in areas that have historically had little generation
- Rapid development of wind has outpaced the associated transmission development
 - Who pays to expand the transmission system?

Wind in the Midwest ISO



How Does this Impact Operations?

- Current market design classifies wind as an Intermittent Resource and cannot economically dispatch
- In areas with high wind penetration, it is difficult for the SCED to manage congestion with only dispatchable resources

2009 Wind Curtailment Data

<i>Month</i>	<i>Number Of Wind Curtailments</i>	<i>Total MWhR Curtailed</i>	<i>Duration (Hours)</i>
January	26	3152	104
February	62	11191	292
March	165	29198	687
April	172	39841	1237
May	149	18480	818
June	90	20687	376
July	46	9272	238
August	66	16161	535
September	9	643	127
October	116	11362	924
November	165	27173	1170
December	75	13002	475
2009-Total	1141	200162	6983

On-Going Wind Integration Efforts

Wind Integration Initiative

- Established to take a comprehensive look at wind issues impacting Midwest ISO
 - Planning
 - Operations
 - Market
- Multiple issues/solutions examined
 - First significant outcome – “Dispatchable Intermittent Resource”

Dispatchable Intermittent Resource

Design Highlights

- Create the market rules and logic to allow Intermittent Resources to register in the Markets
- Max Limit to be determined from current conditions, such as RT forecast, rather than directly from Offer data
- Solution allows for Resources that have real-time-dependent max limits to set price, with the same general offer structure that is available to other Resource types.
- Additional considerations: performance requirements and charges (similar to Excessive/Deficient energy), forecast source, implementation timeline

Who Benefits from Dispatchable Intermittent Resources?

- Broader Market: Operational efficiency, market efficiency and market transparency, level playing field
- Wind and other DI Resources: Full participation in markets; make-whole eligible, transparent dispatch

Stakeholder Timeline

- December – August Stakeholder Meetings
 - Preliminary Discussion and Timeline
 - Comments accepted
 - Design Discussions
 - Comments accepted after these meetings
- Finalized design presented to stakeholders in July
- Tariff Sheets posted and will be considered at the August Market Subcommittee
- FERC filing scheduled for September
- Implementation expected Spring 2011

For More Information

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